ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
20 September 2021

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

Summary

Summary

ENSO Alert System Status: La Niña Watch

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are near-to-below average across most of the Pacific Ocean.

A transition from ENSO-neutral to La Niña is favored in the next couple of months, with a 70-80% chance of La Niña during the Northern Hemisphere winter 2021-22.*

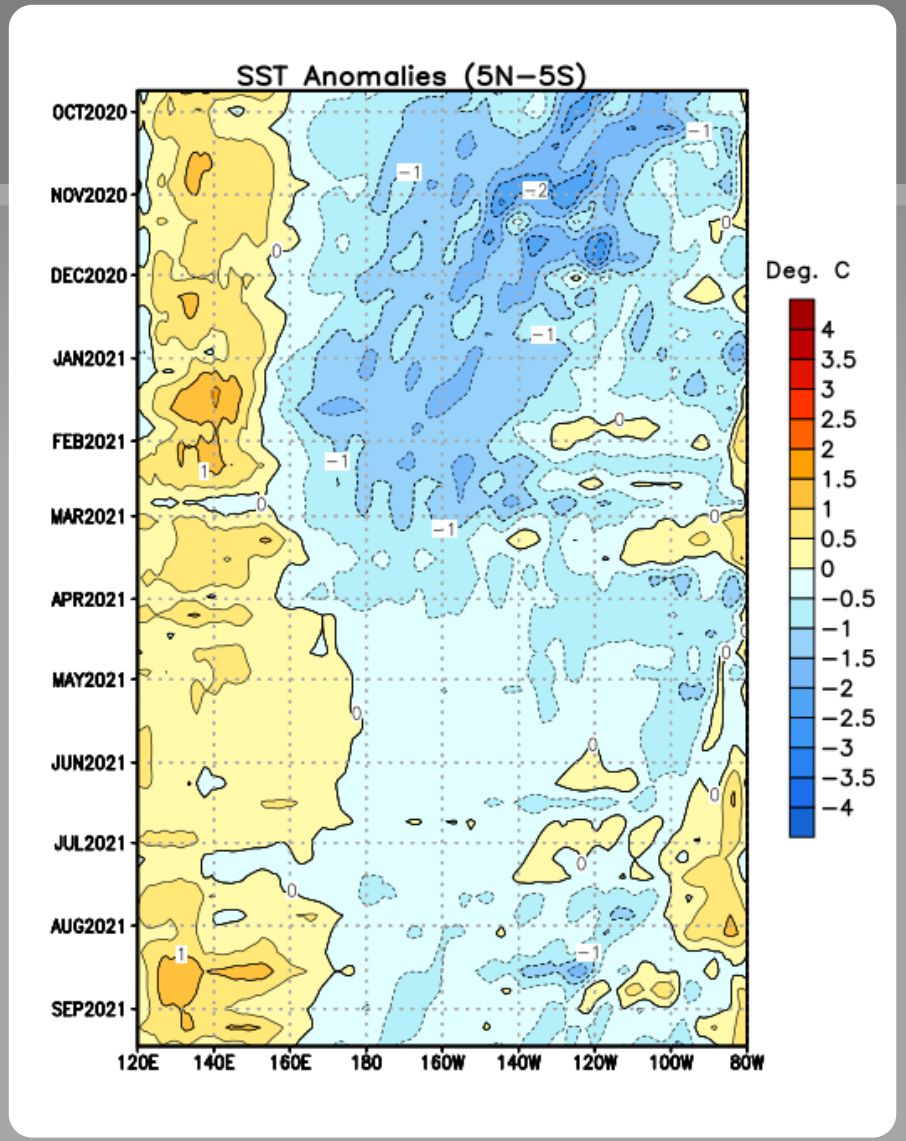
* Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.

Recent Evolution of Equatorial Pacific SST Departures (ºC)

During September 2020 to March 2021, the core of the strongest negative SST anomalies shifted from the eastern to the central Pacific Ocean.

From March to July 2021, equatorial SSTs gradually returned to average over most of the Pacific Ocean.

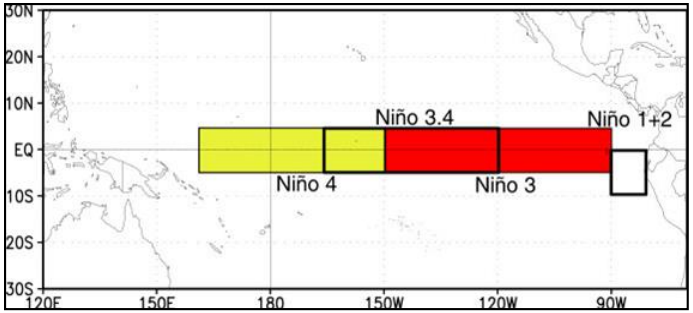
In the last week, near-to-below average SSTs continued in the central and east-central Pacific Ocean.

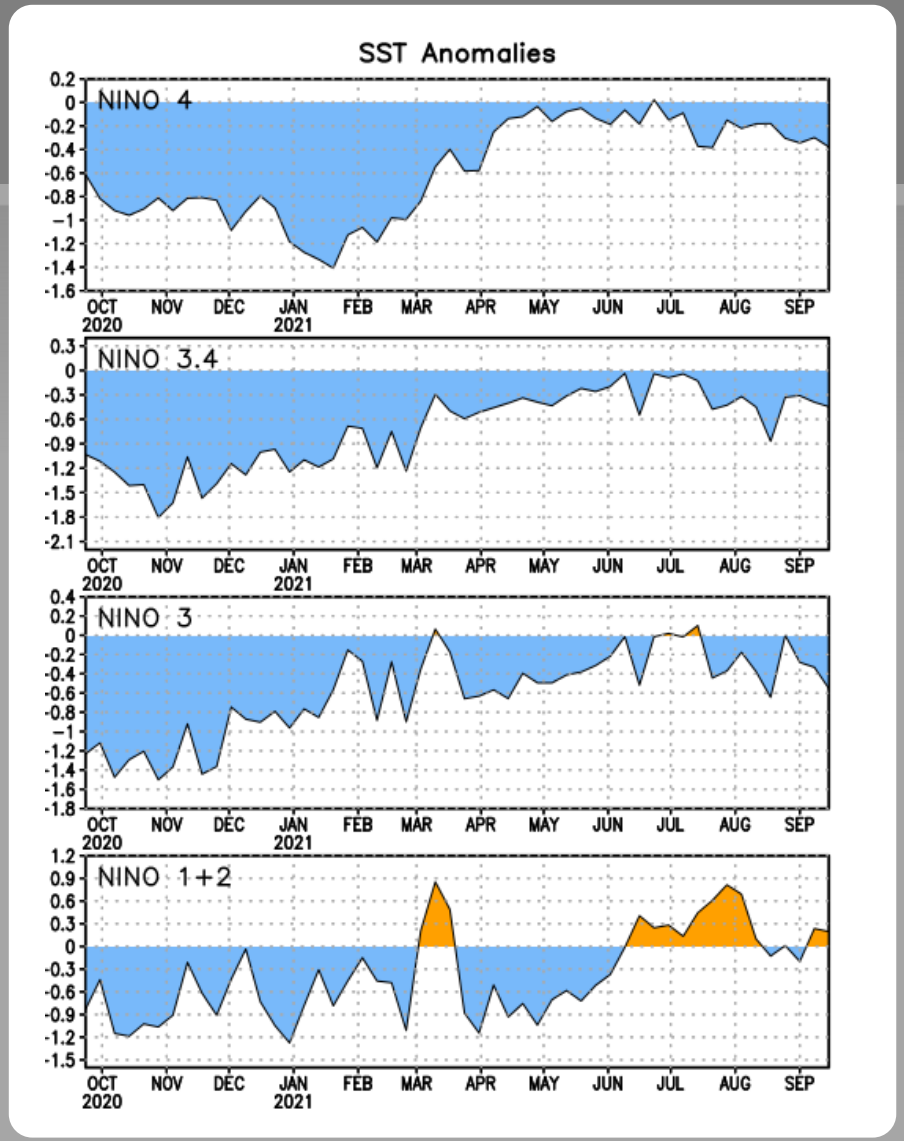


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

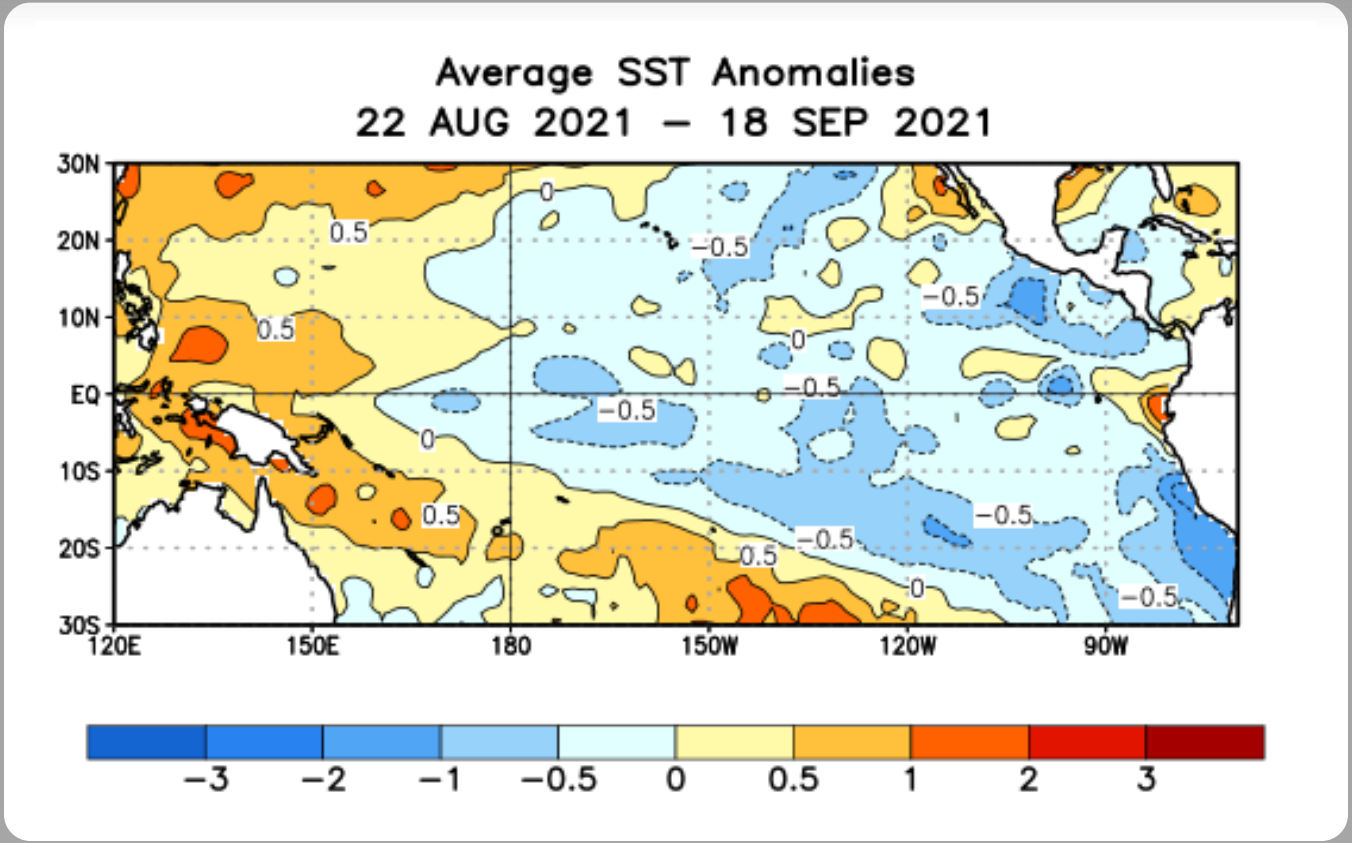
Niño 4	-0.4ºC
Niño 3.4	-0.4ºC
Niño 3	-0.6ºC
Niño 1+2	0.2ºC





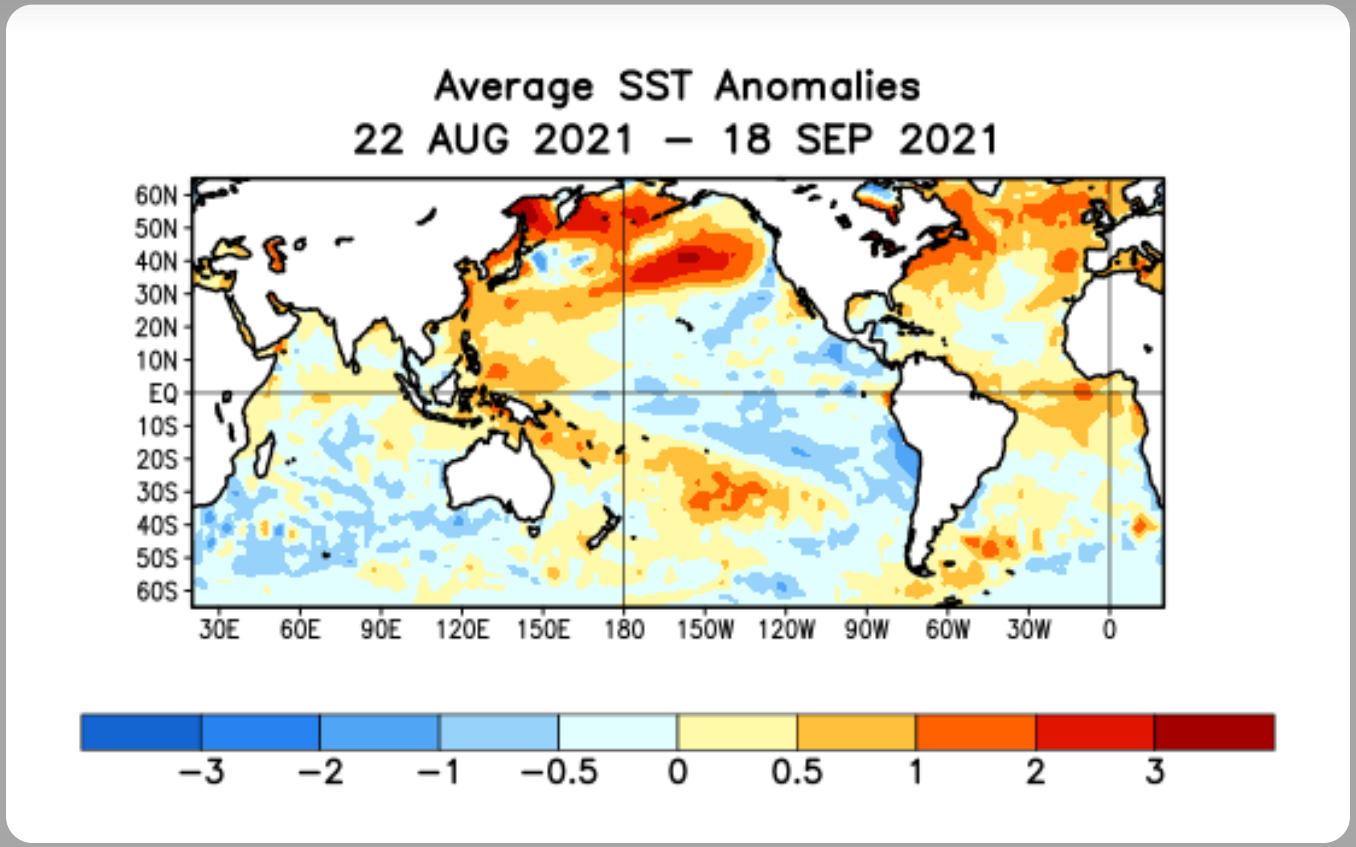
SST Departures (ºC) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were near-to-below average across most of the equatorial Pacific Ocean, and were above average in the western Pacific Ocean.



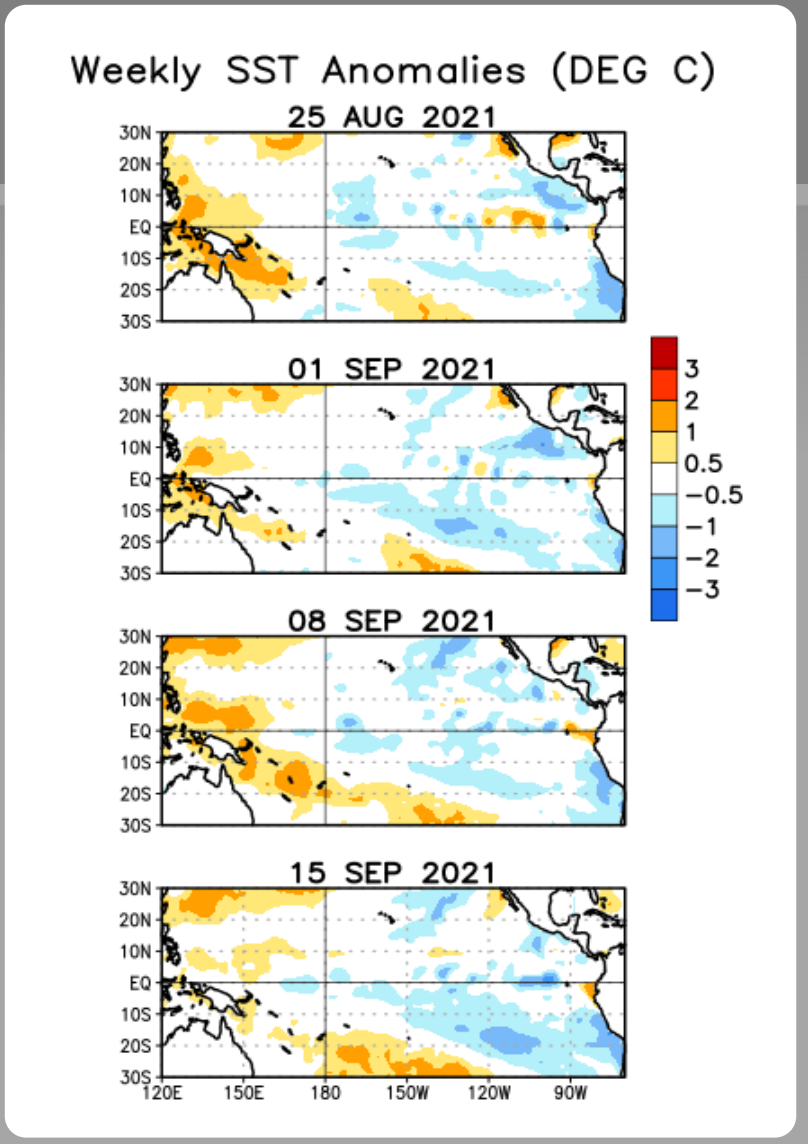
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were near-to-below average across most of the equatorial Pacific Ocean. Equatorial SSTs were above average in the western Pacific Ocean, Atlantic Ocean, and near Indonesia.



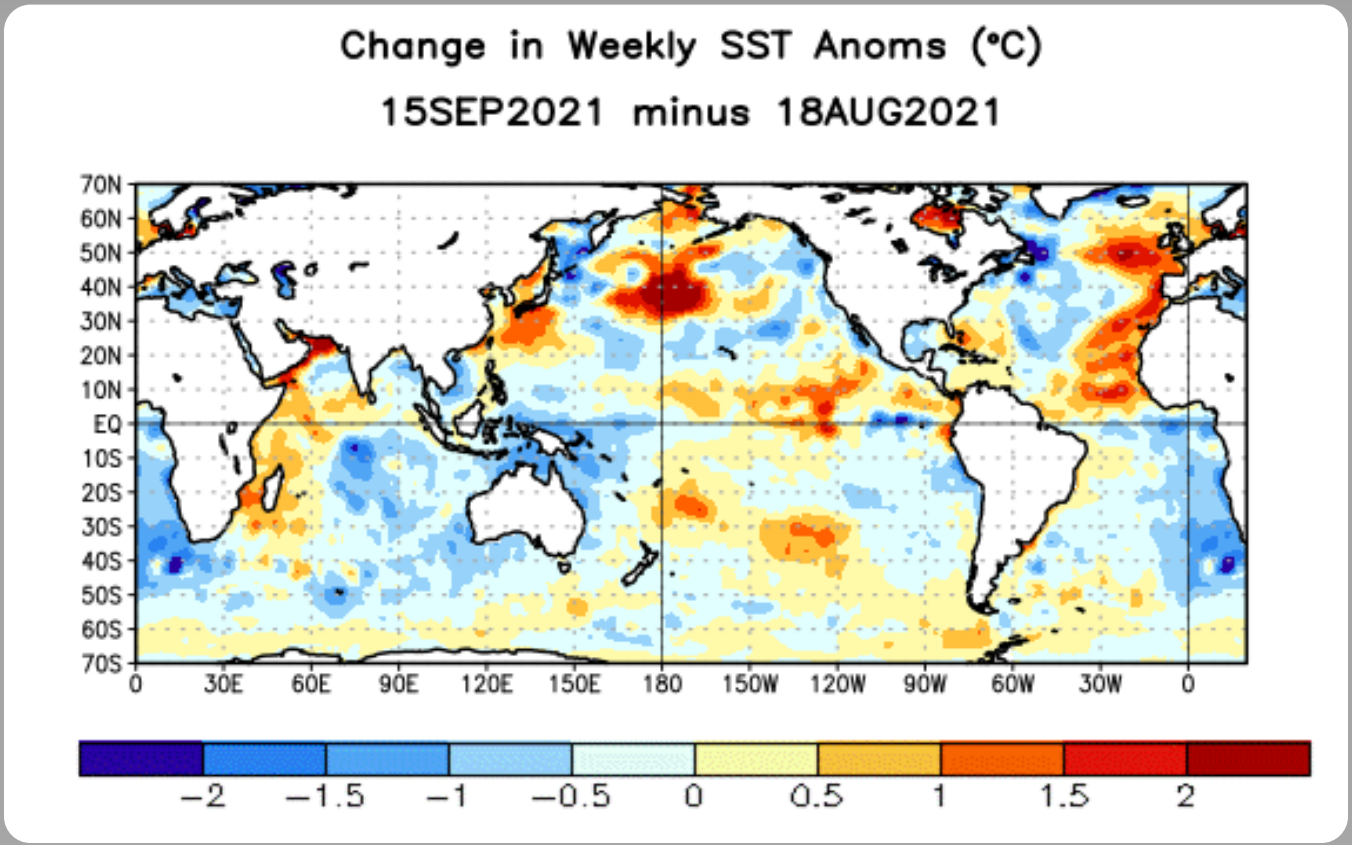
Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, SSTs have been mostly near-to-below average in the central and east-central Pacific Ocean.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, the changes in equatorial SST anomalies were positive in the east-central Pacific and next to S. America and negative in the eastern and western Pacific.



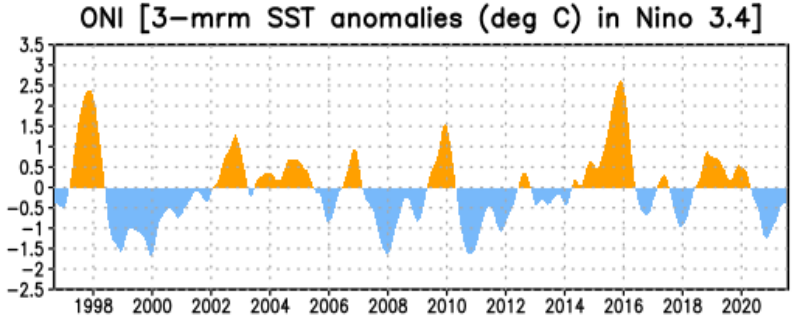
Upper-Ocean Conditions in the Equatorial Pacific

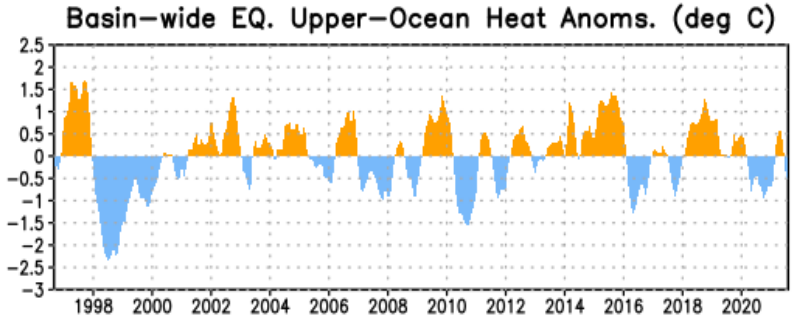
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

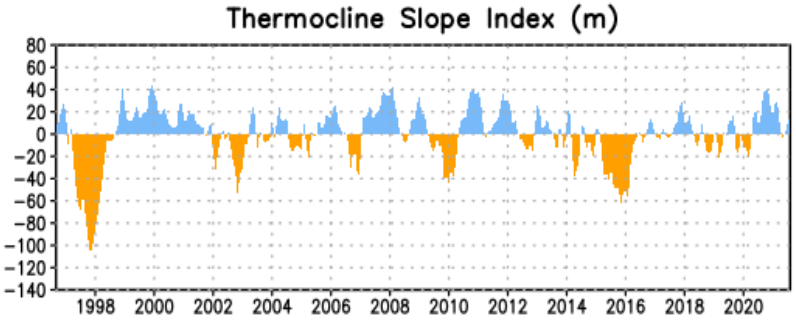
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

Recent values of the upper-ocean heat anomalies (near-to-below average) and thermocline slope index (near average) reflect ENSO-neutral.

The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

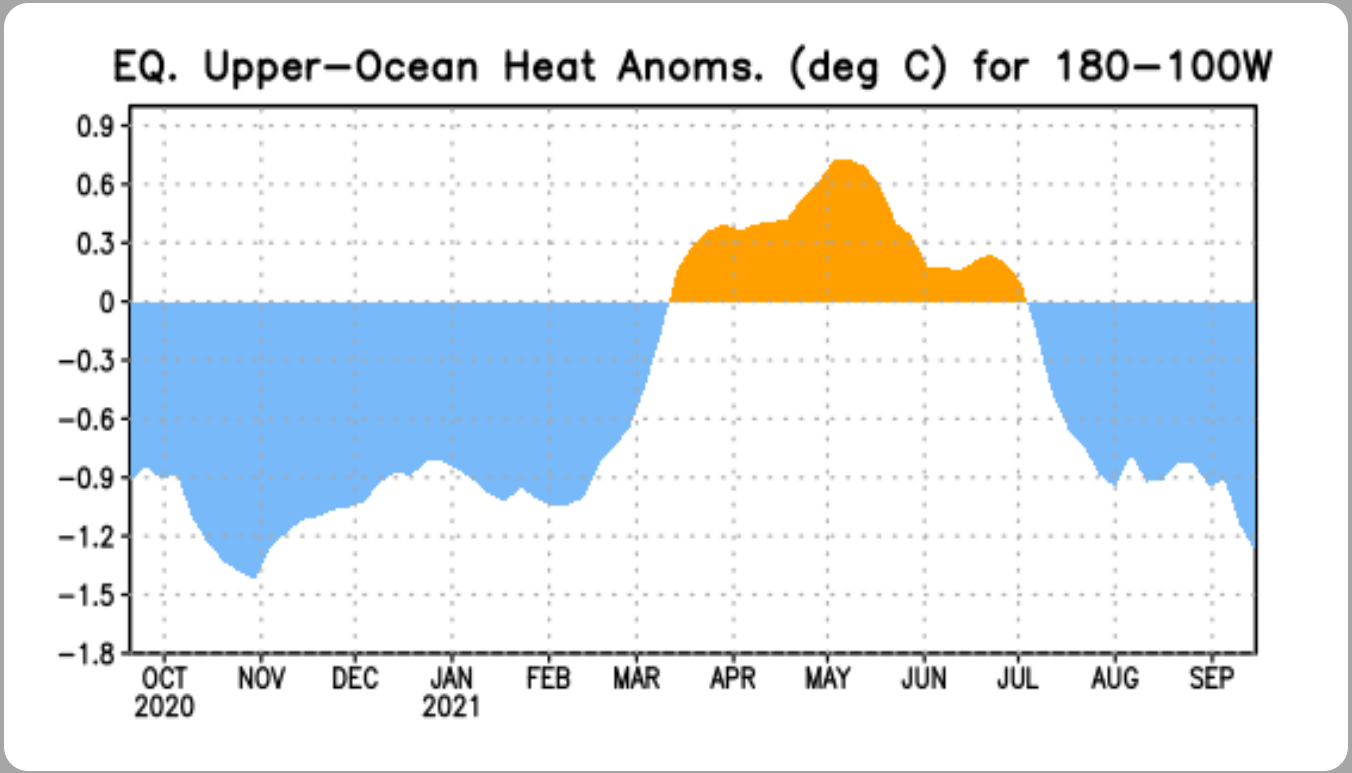






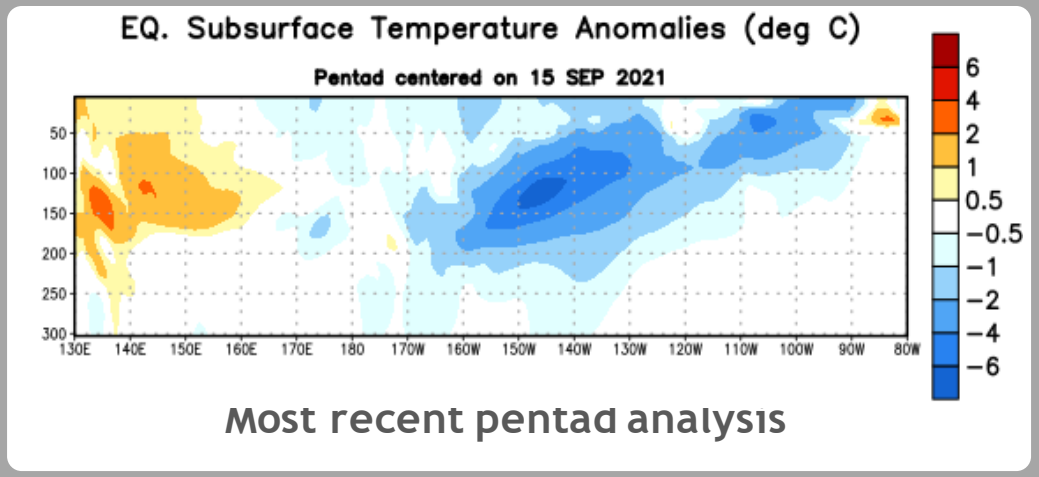
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Negative subsurface temperature anomalies persisted into March 2021. From mid-March to early July 2021, subsurface temperature was above average. Since mid-May 2021, positive temperature anomalies have weakened. Negative anomalies strengthened in July and again in mid-September.



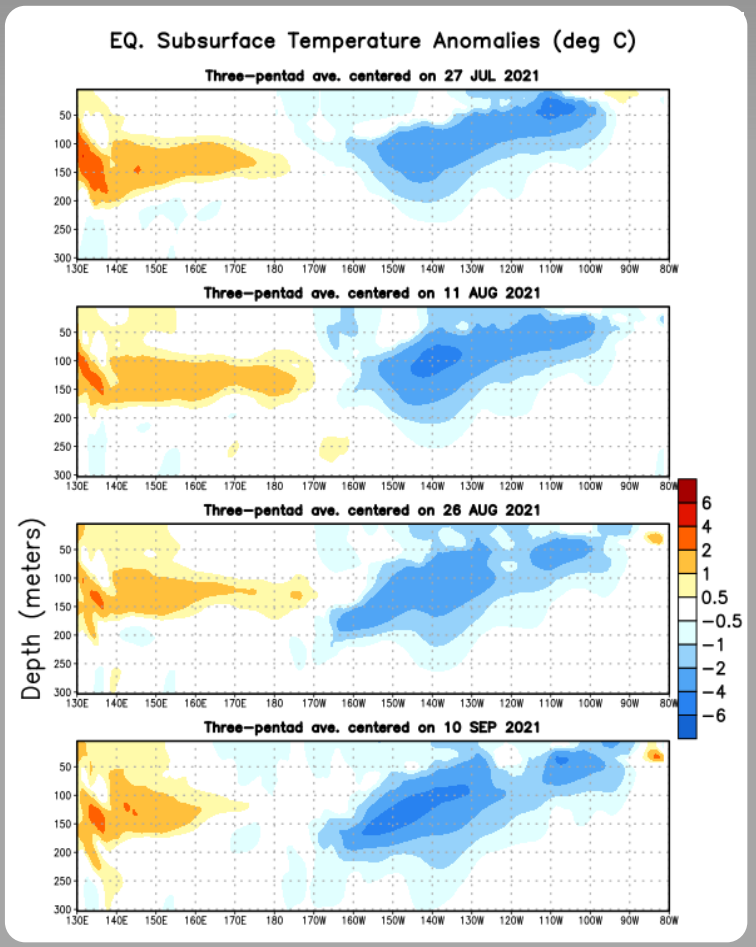
Sub-Surface Temperature Departures in the Equatorial Pacific

In the last two months, negative subsurface anomalies have strengthened in the east-central Pacific Ocean.



Most recent pentad analysis

Positive subsurface temperature anomalies remain at depth in the western Pacific Ocean, but have weakened near the Date Line in the past month.

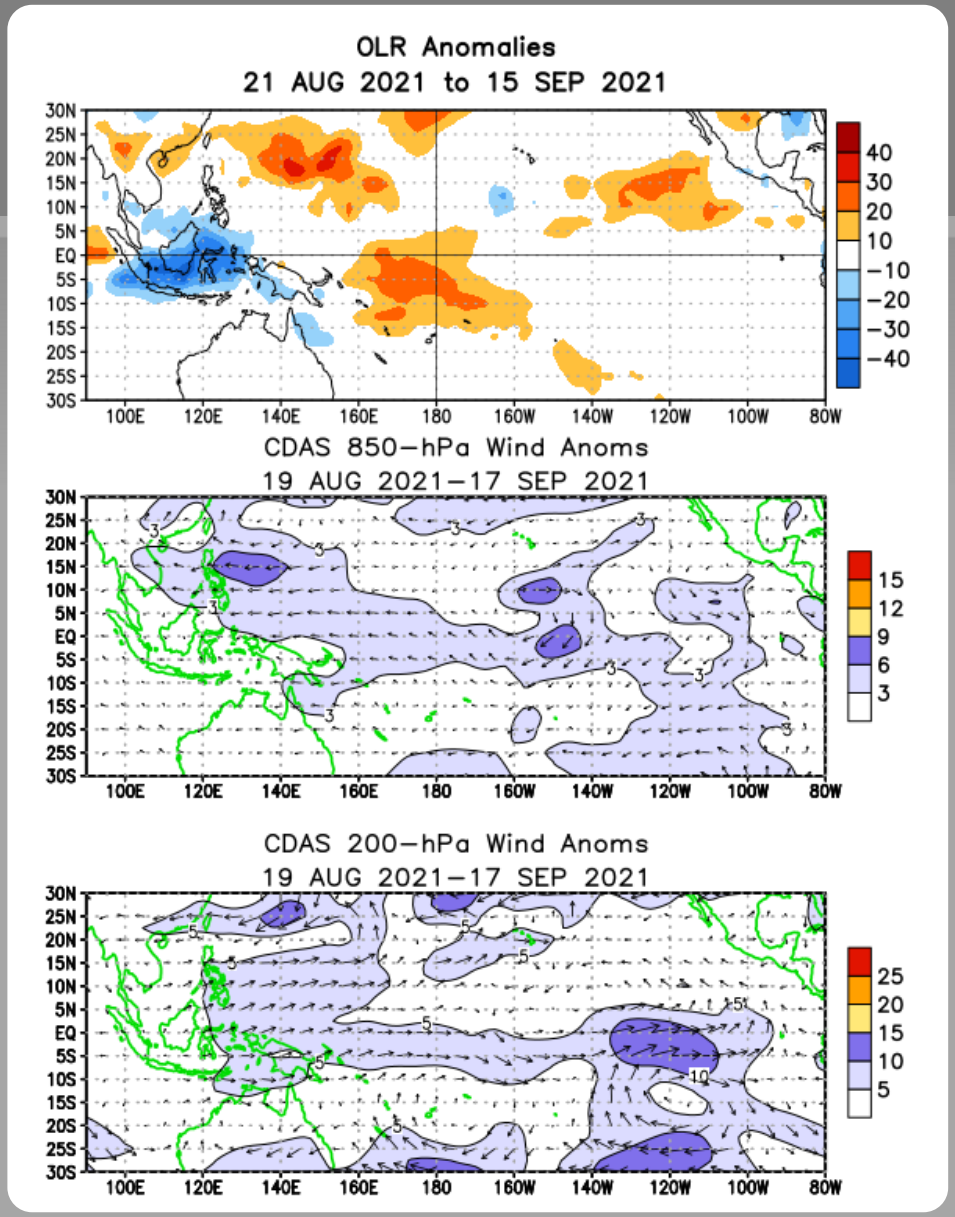


Tropical OLR and Wind Anomalies During the Last 30 Days

Positive OLR anomalies (suppressed convection and precipitation) were located over the central Pacific Ocean. Negative OLR anomalies (enhanced convection and precipitation) were observed over Indonesia.

Low-level (850-hPa) easterly wind anomalies were evident over most of the tropical Pacific Ocean, and anomalous cross-equatorial winds were located over the east-central Pacific Ocean.

Upper-level (200-hPa) westerly wind anomalies were observed over most of the equatorial Pacific Ocean.



Intraseasonal Variability

Intraseasonal variability in the atmosphere (wind and pressure), which is often related to the Madden-Julian Oscillation (MJO), can significantly impact surface and subsurface conditions across the Pacific Ocean.

Related to this activity:

Significant weakening of the low-level easterly winds usually initiates an eastward-propagating oceanic Kelvin wave.

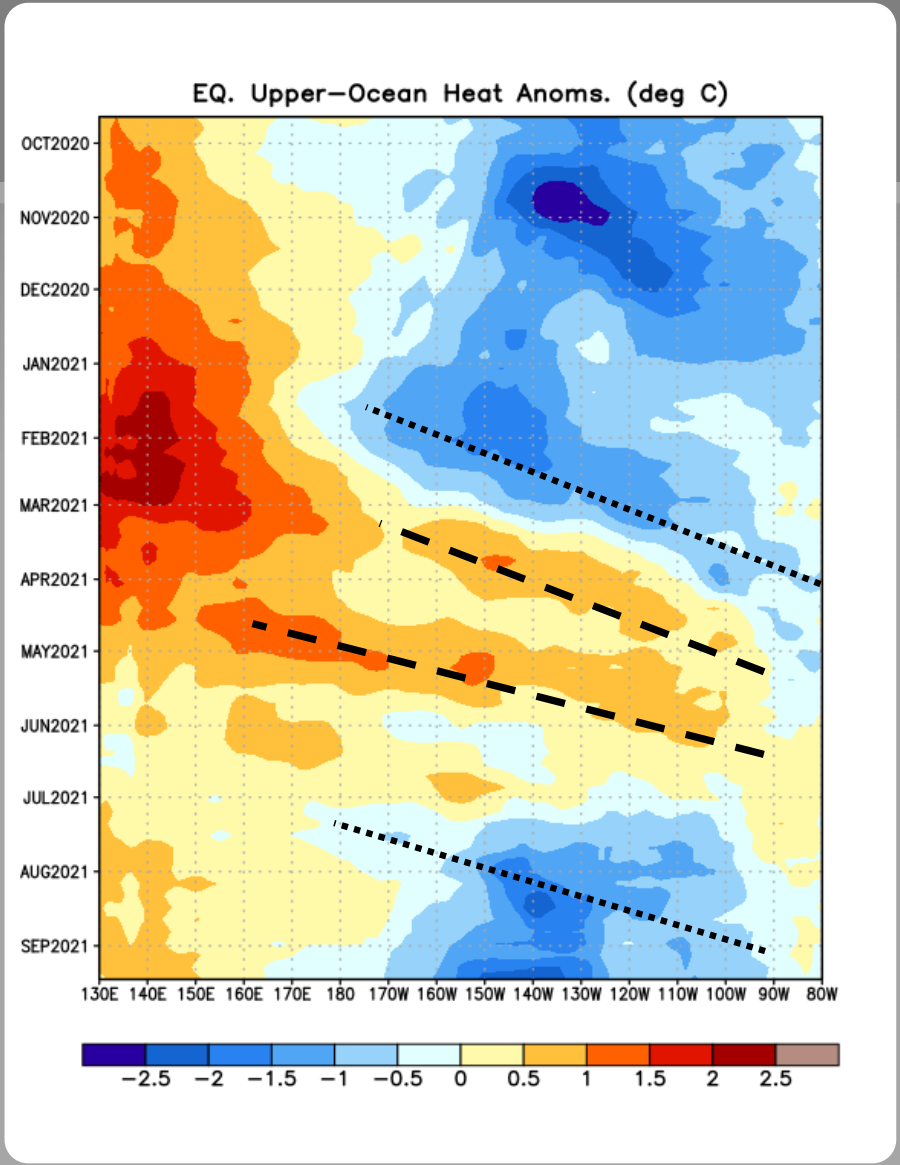
Weekly Heat Content Evolution in the Equatorial Pacific

Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

From August 2020 to February 2021, negative subsurface temperature anomalies persisted in the eastern half of the Pacific Ocean.

During March through May 2021, positive anomalies shifted eastward in association with two downwelling Kelvin waves.

In July, negative subsurface temperature anomalies emerged. In mid-September, negative anomalies in the east-central Pacific strengthened.

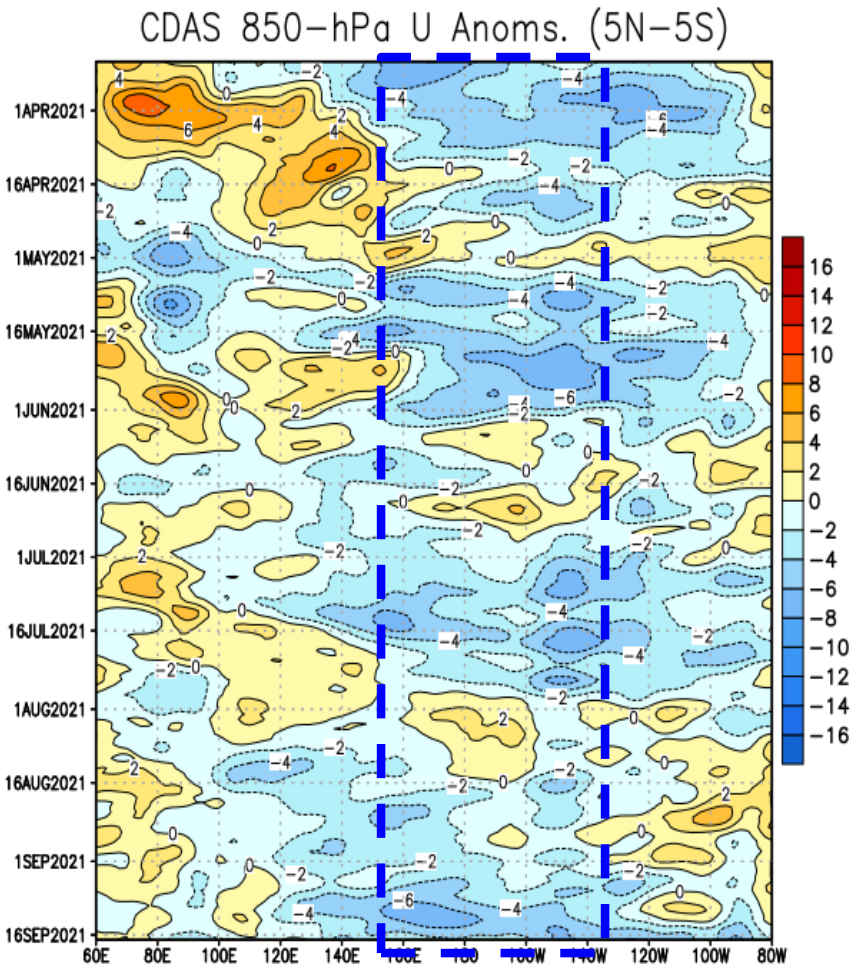


Equatorial oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})

At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

Since the beginning of the period, easterly wind anomalies have generally dominated over the central and east-central Pacific during the period, except for breaks during late April, mid-June, and early-to-mid-August.

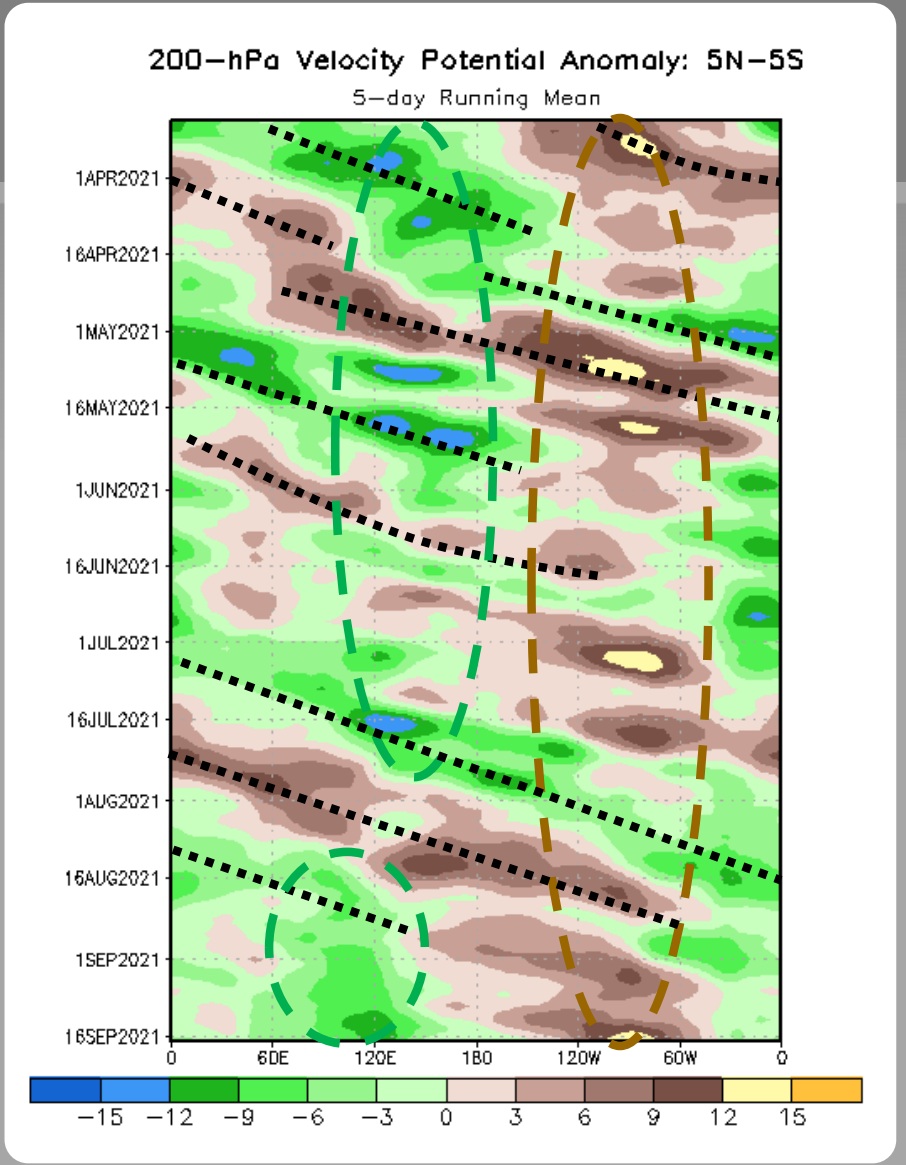


Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

During most of the period, anomalous divergence (green shading) generally remained over Indonesia, while anomalous convergence (brown shading) persisted over the eastern Pacific Ocean.

From early July through mid-August, eastward propagation of anomalies was evident.



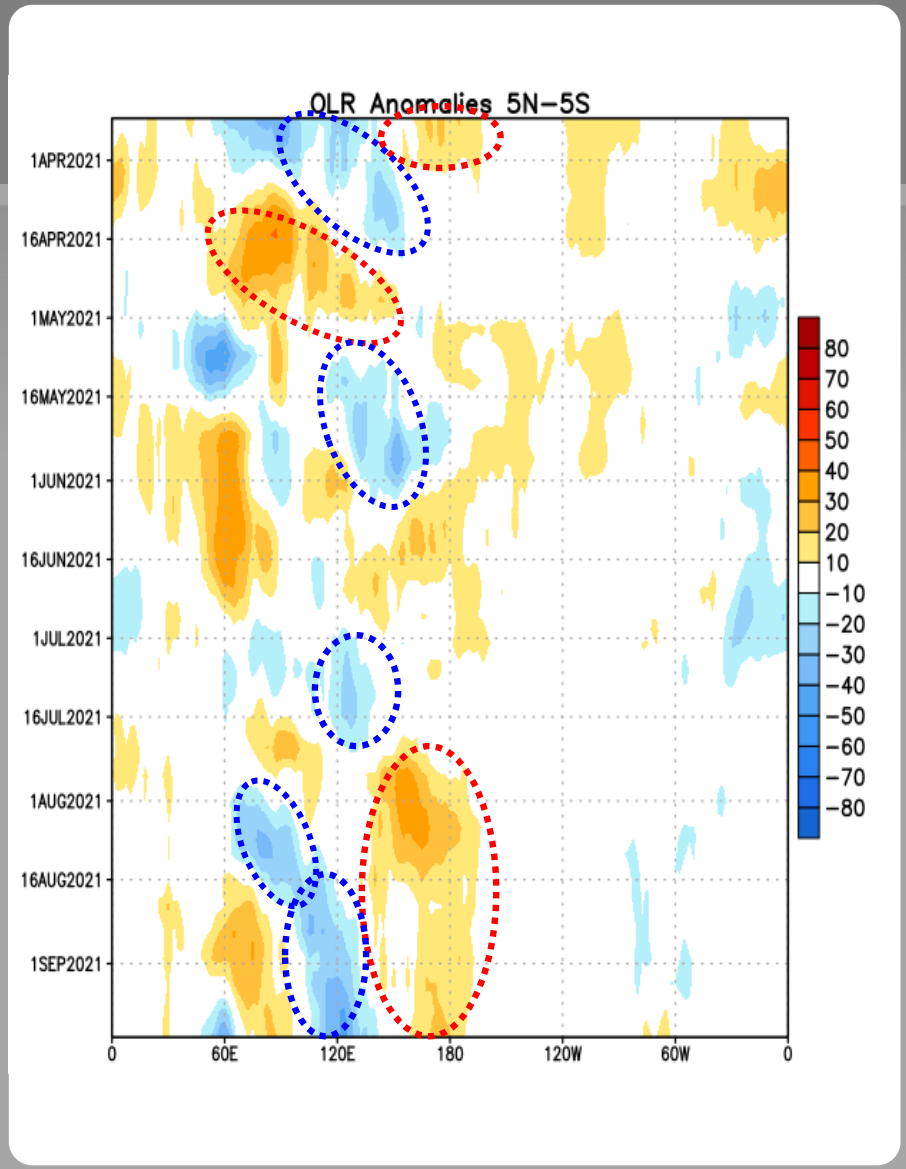
Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)

Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

Outgoing Longwave Radiation (OLR) Anomalies

Since late July 2021, positive OLR anomalies were evident over the western or central Pacific Ocean.

Since mid-August 2021, negative OLR anomalies were evident over Indonesia.



Drier-than-average Conditions (orange/red shading)
Wetter-than-average Conditions (blue shading)

Oceanic Niño Index (ONI)

The ONI is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.

Defined as the three-month running-mean SST departures in the Niño 3.4 region. Departures are based on a set of improved homogeneous historical SST analyses (Extended Reconstructed SST – ERSST.v5). The SST reconstruction methodology is described in Huang et al., 2017, J. Climate, vol. 30, 8179-8205.)

It is one index that helps to place current events into a historical perspective

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a positive ONI greater than or equal to +0.5°C.

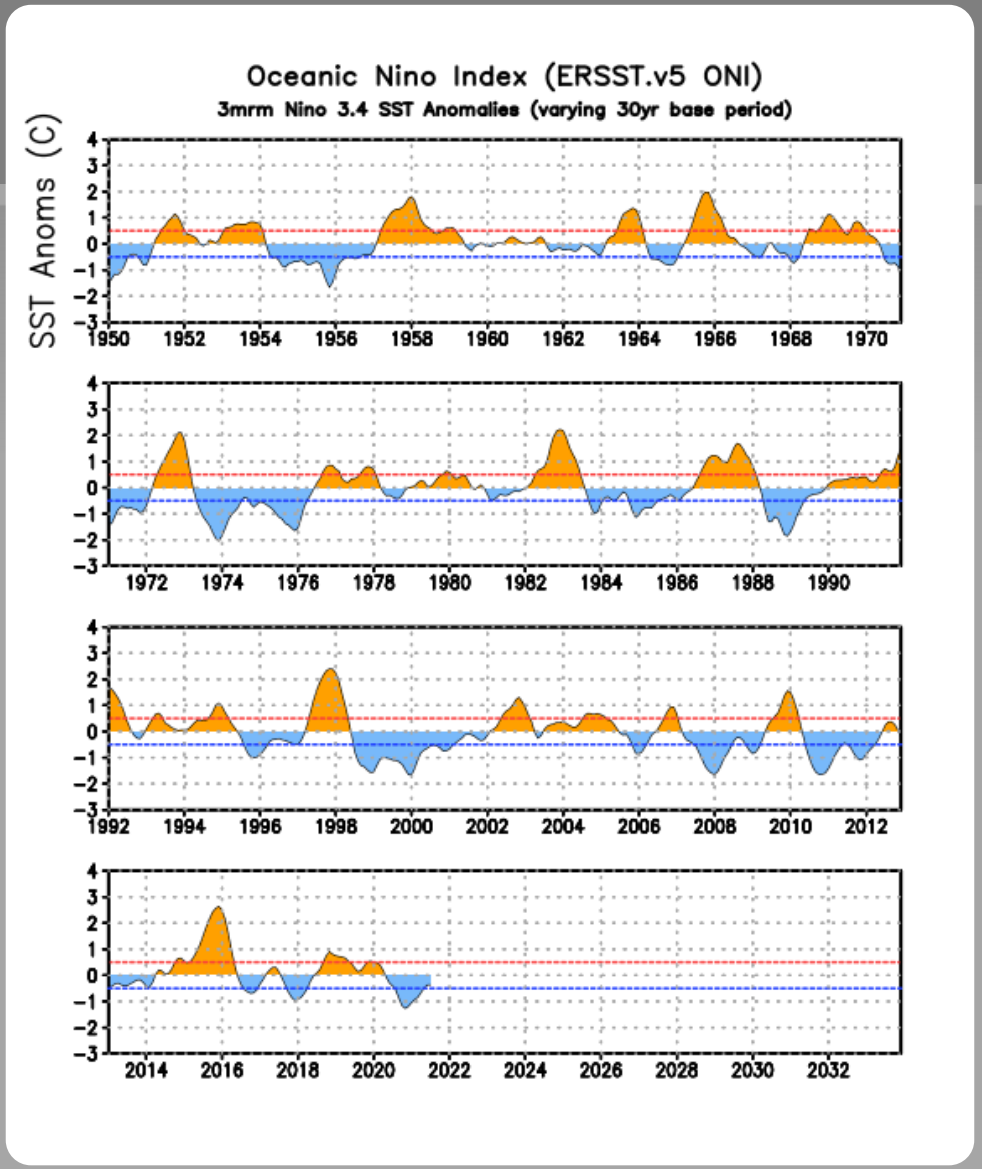
La Niña: characterized by a negative ONI less than or equal to -0.5°C.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5°C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

ONI (°C): Evolution since 1950

The most recent ONI value (June - August 2021) is -0.4°C.



Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v5

Recent Pacific warm (red) and cold (blue) periods based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v5 SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes, periods of below and above normal SSTs are colored in blue and red when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

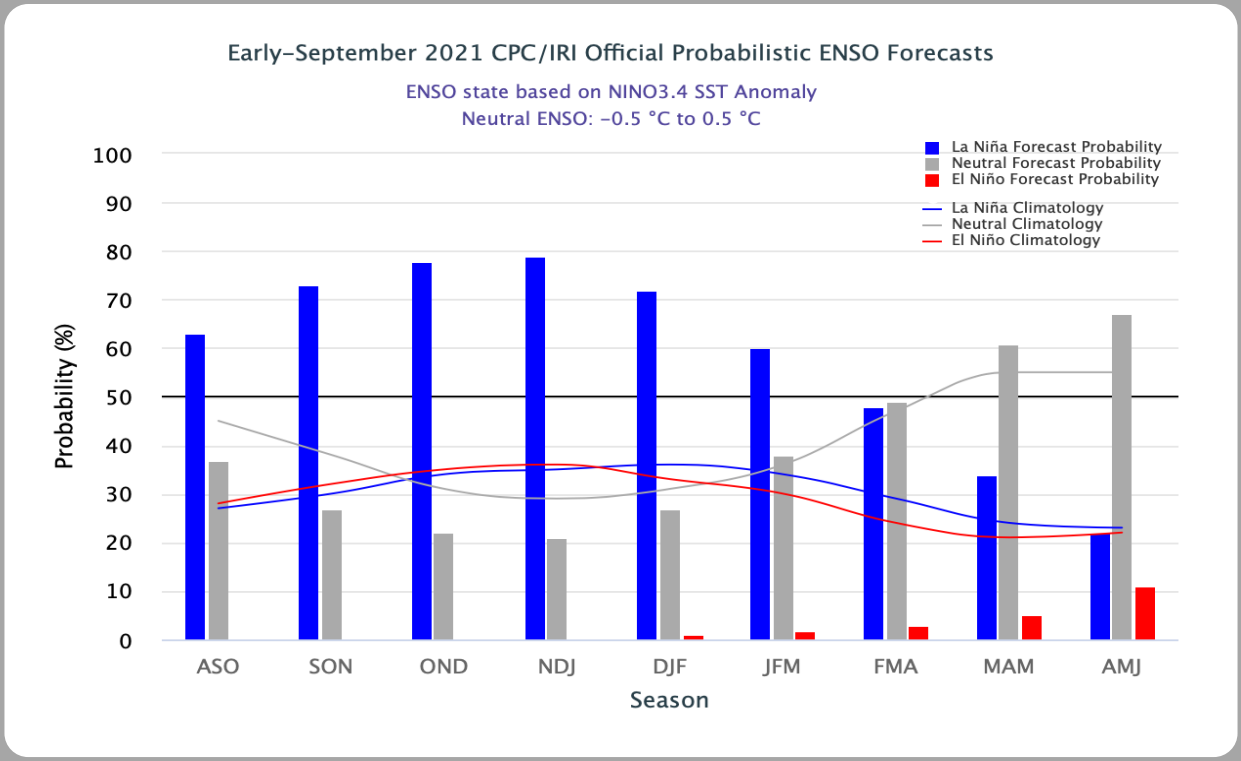
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2009	-0.8	-0.8	-0.6	-0.3	0.0	0.3	0.5	0.6	0.7	1.0	1.4	1.6
2010	1.5	1.2	0.8	0.4	-0.2	-0.7	-1.0	-1.3	-1.6	-1.6	-1.6	-1.6
2011	-1.4	-1.2	-0.9	-0.7	-0.6	-0.4	-0.5	-0.6	-0.8	-1.0	-1.1	-1.0
2012	-0.9	-0.7	-0.6	-0.5	-0.3	0.0	0.2	0.4	0.4	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.5	-0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.5	0.6	0.7
2015	0.5	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.2	2.4	2.6	2.6
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4	-0.5	-0.6	-0.7	-0.7	-0.6
2017	-0.3	-0.2	0.1	0.2	0.3	0.3	0.1	-0.1	-0.4	-0.7	-0.8	-1.0
2018	-0.9	-0.9	-0.7	-0.5	-0.2	0.0	0.1	0.2	0.5	0.8	0.9	0.8
2019	0.7	0.7	0.7	0.7	0.5	0.5	0.3	0.1	0.2	0.3	0.5	0.5
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4					

CPC/IRI Probabilistic ENSO Outlook

Updated: 9 September 2021

La Niña is favored during the Northern Hemisphere fall and winter 2021-22.



IRI/CPC Pacific Niño 3.4 SST Model Outlook

Most models indicate borderline or weak La Niña conditions to emerge in fall 2021 and continue into winter 2021-22.

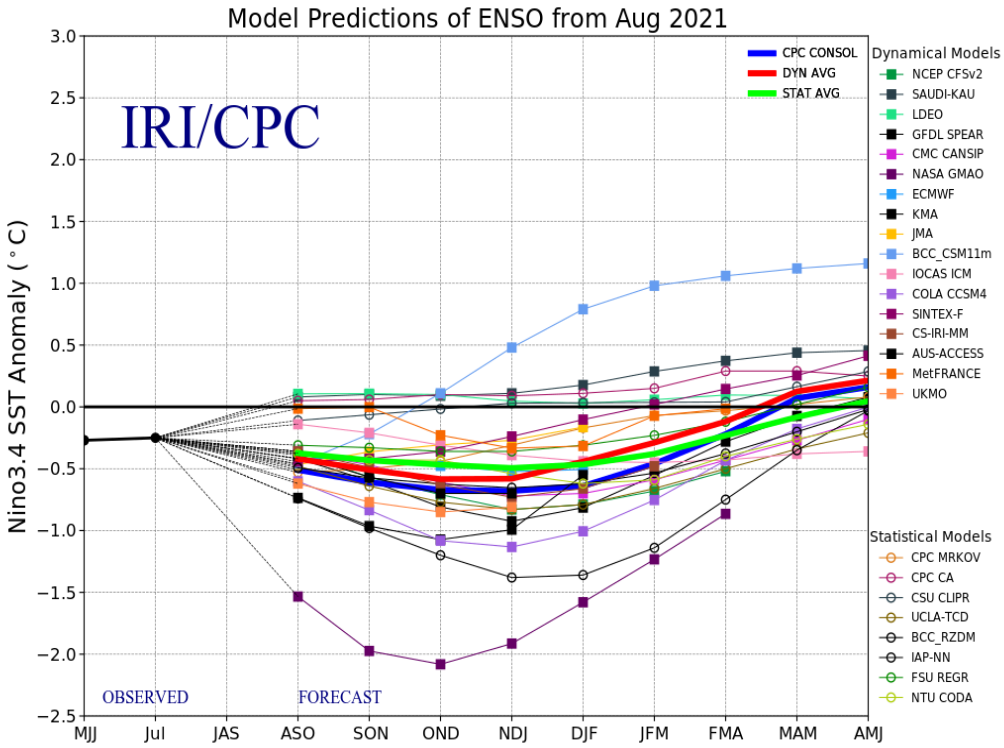
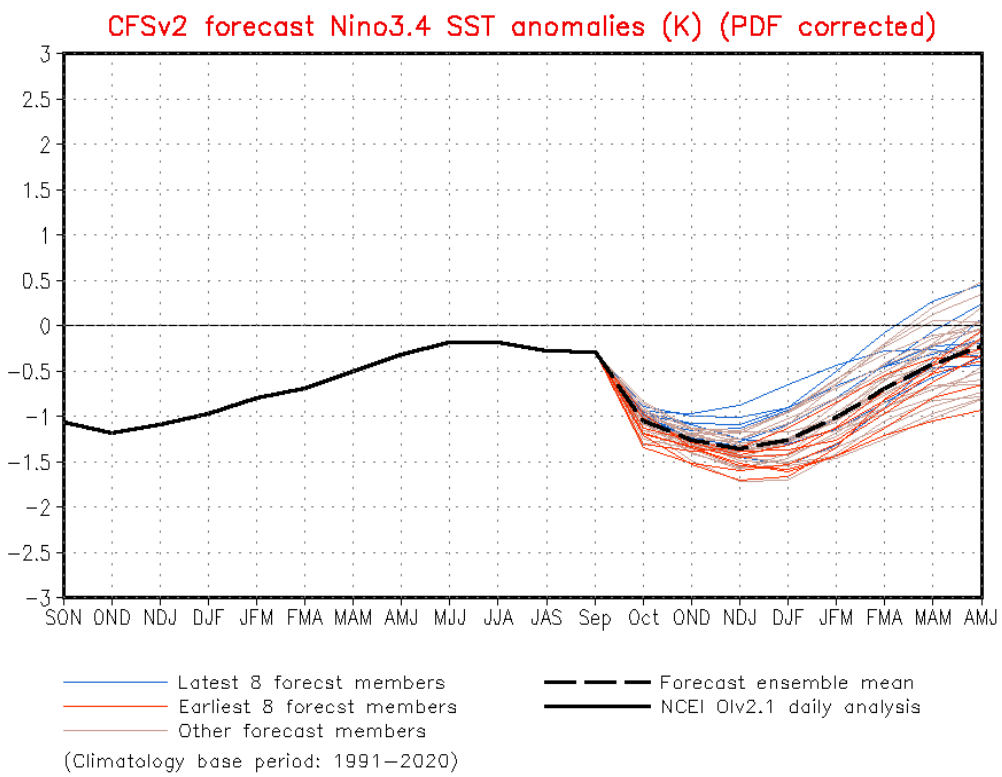


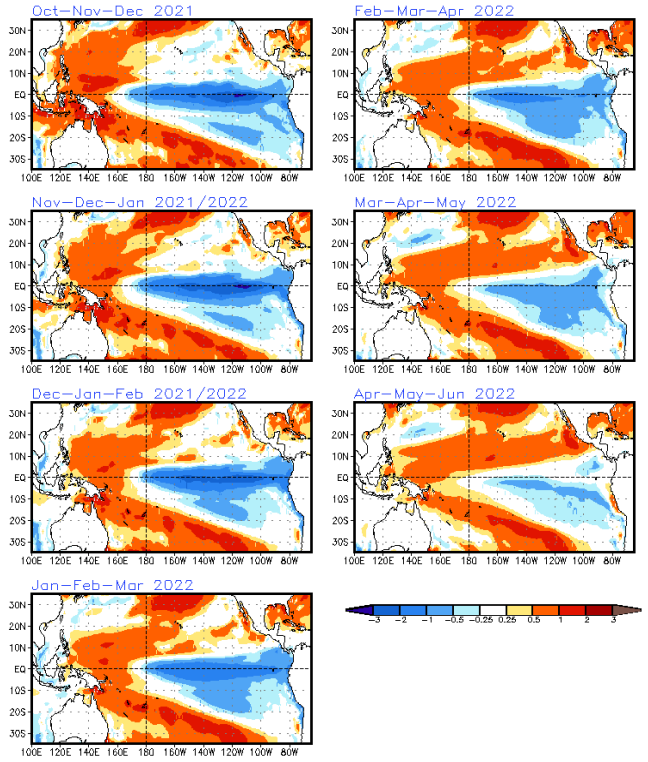
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 August 2021).

SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 20 September 2021

The CFS.v2 ensemble mean (black dashed line) predicts a transition to La Niña in in the next month and La Niña to continue through fall and winter 2021-22.

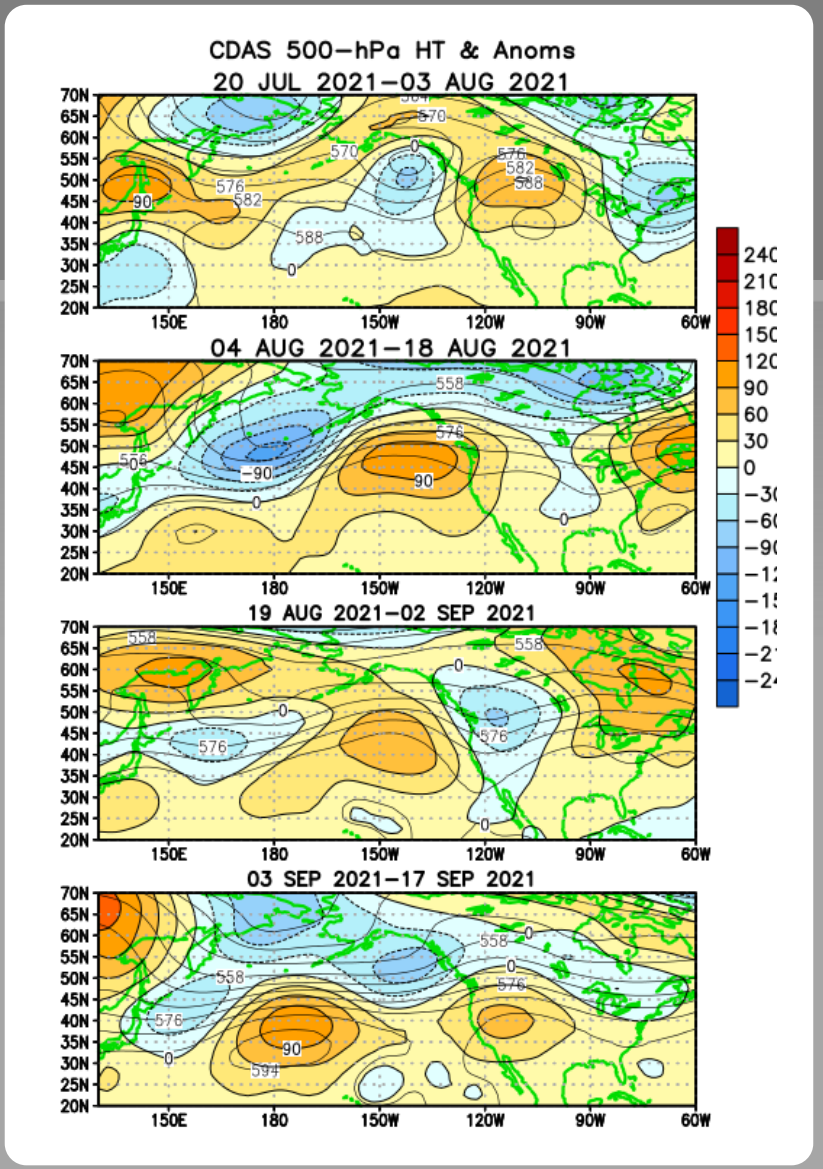




Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From late July to mid-August, above-average heights and temperatures were observed over the northwestern U.S., while below-average heights and temperatures were evident over portions of the southern tier of the U.S.

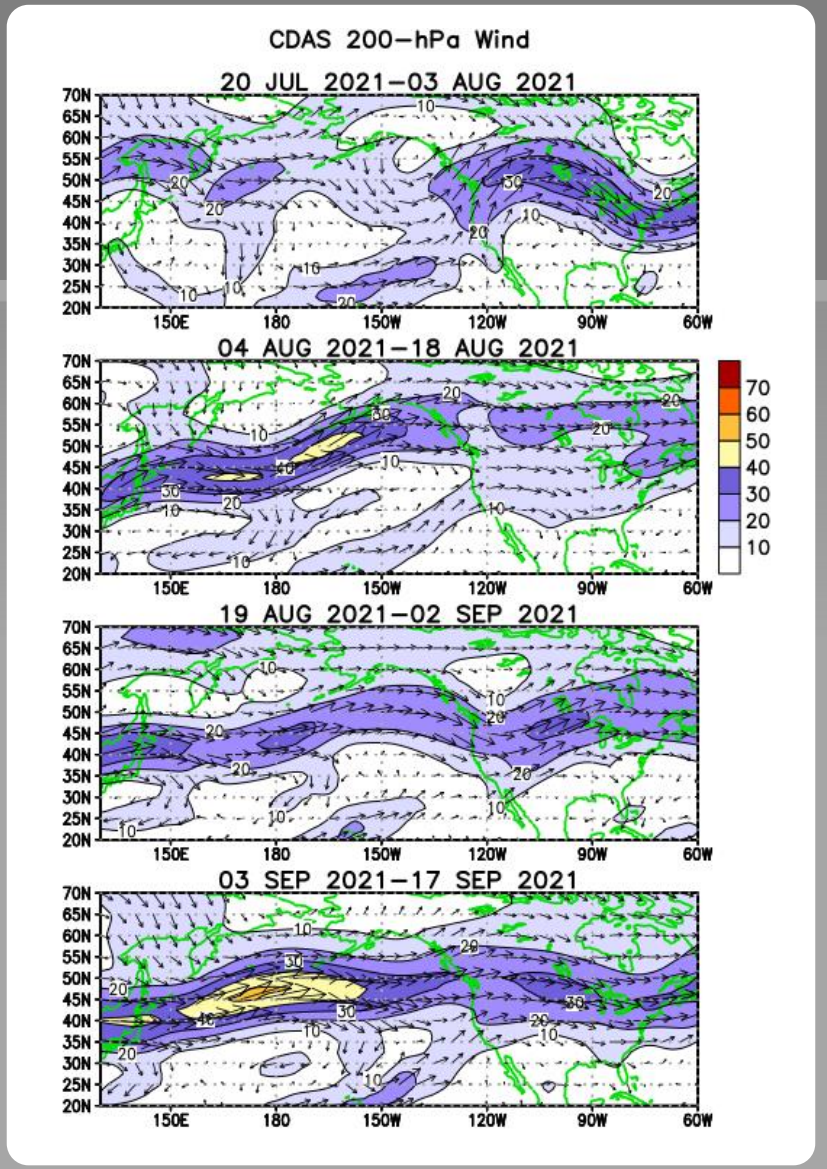
Since early September, above-average conditions were observed over most of the contiguous U.S.



Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From late July to mid-August, above-average heights and temperatures were observed over the northwestern U.S., while below-average heights and temperatures were evident over portions of the southern tier of the U.S.

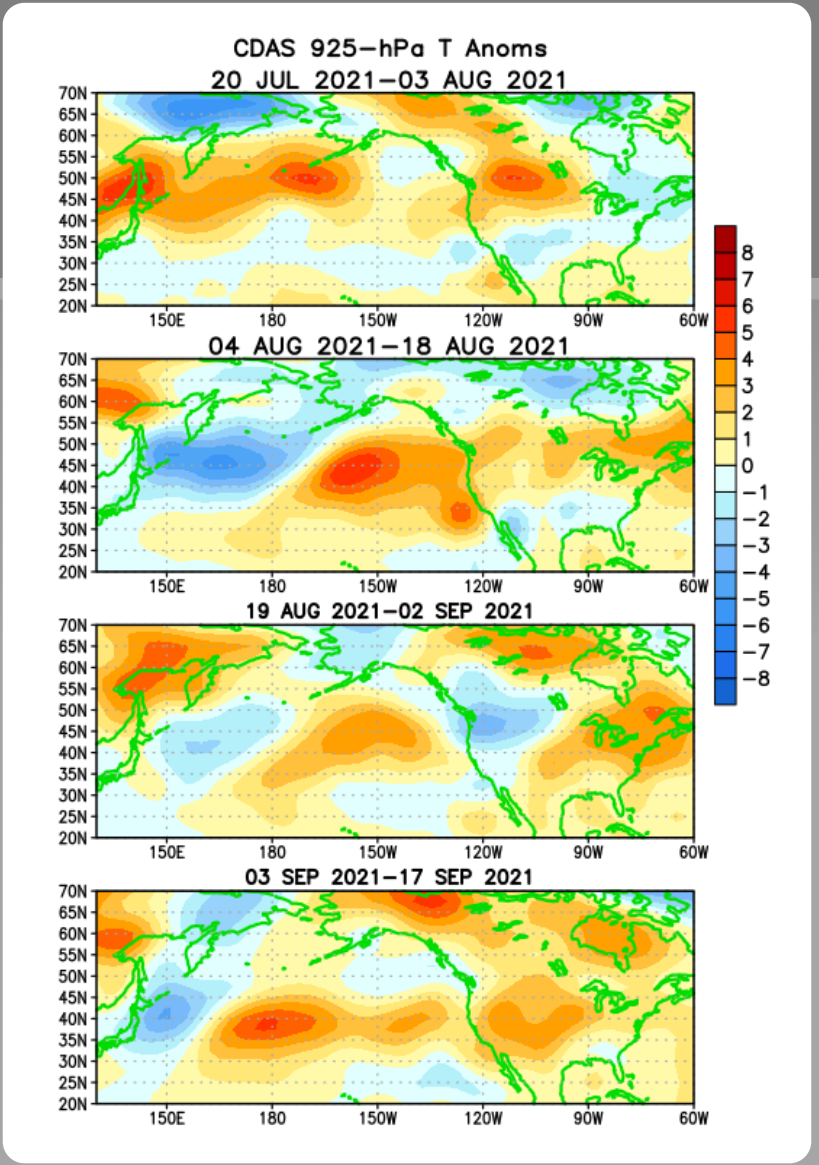
Since early September, above-average conditions were observed over most of the contiguous U.S.



Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From late July to mid-August, above-average heights and temperatures were observed over the northwestern U.S., while below-average heights and temperatures were evident over portions of the southern tier of the U.S.

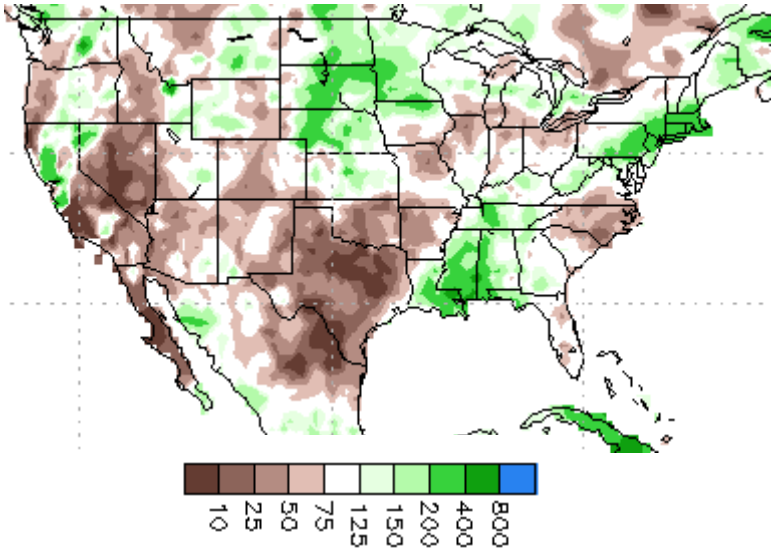
Since early September, above-average conditions were observed over most of the contiguous U.S.



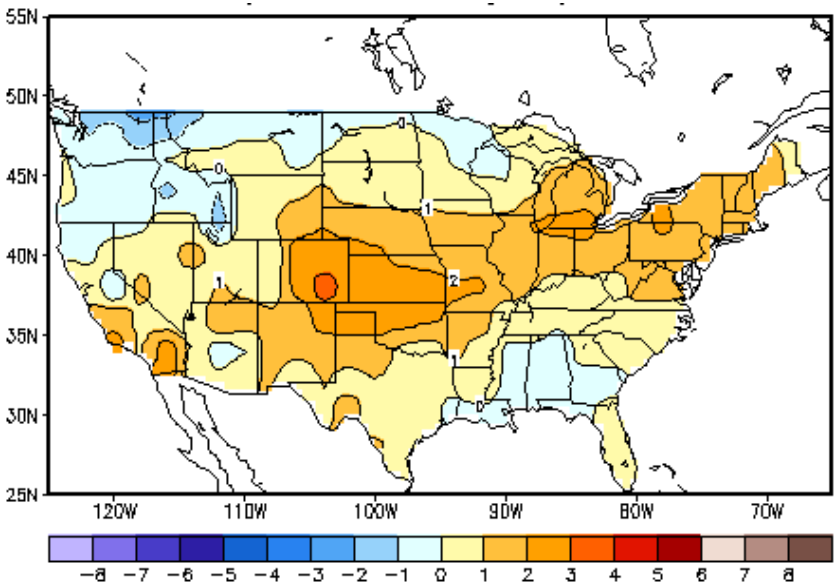
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 18 September 2021

Percent of Average Precipitation



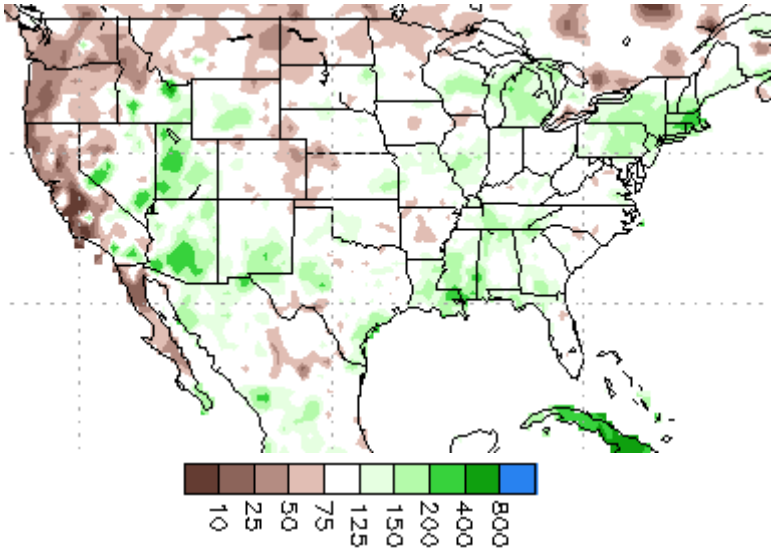
Temperature Departures (degree C)



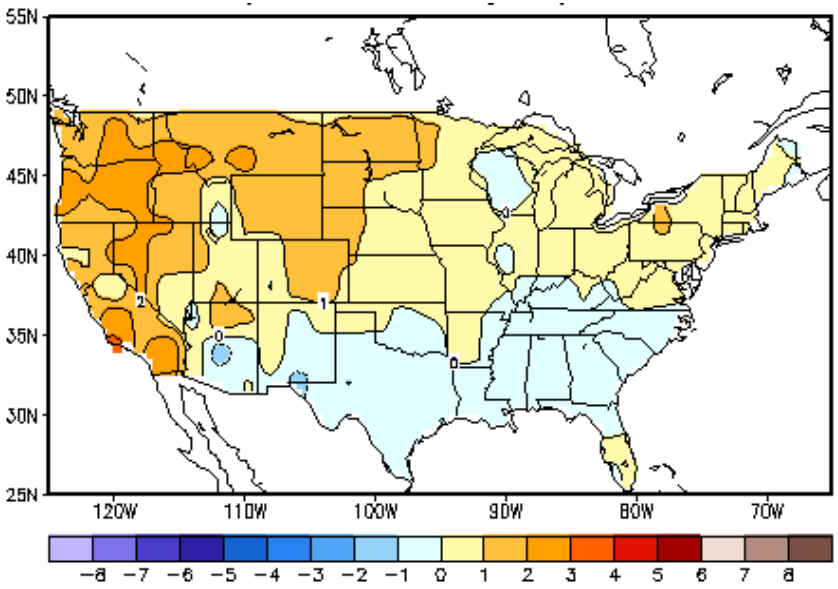
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 18 September 2021

Percent of Average Precipitation



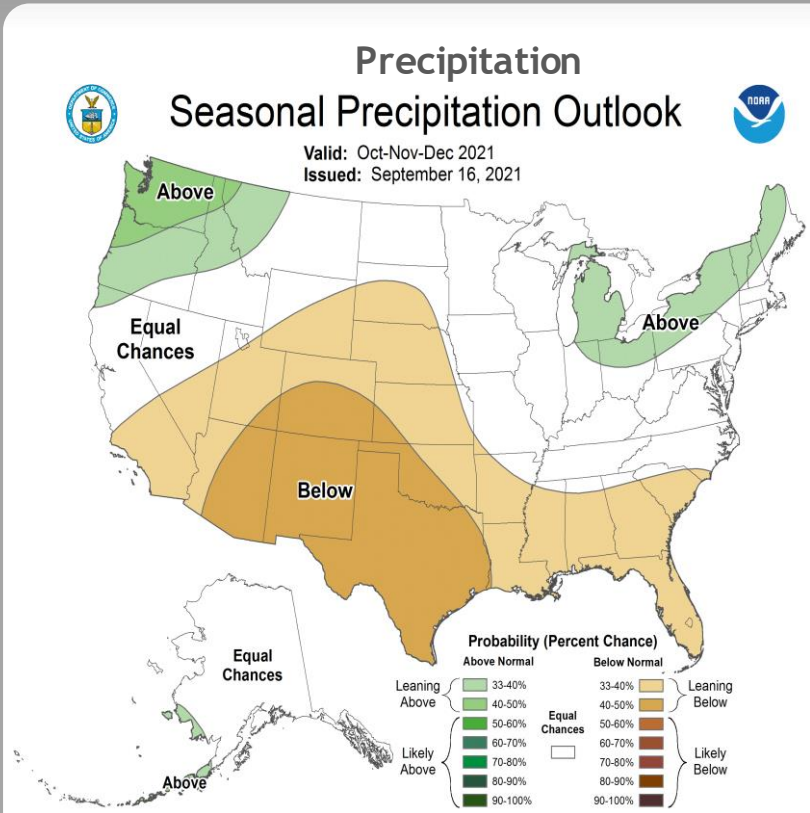
Temperature Departures (degree C)

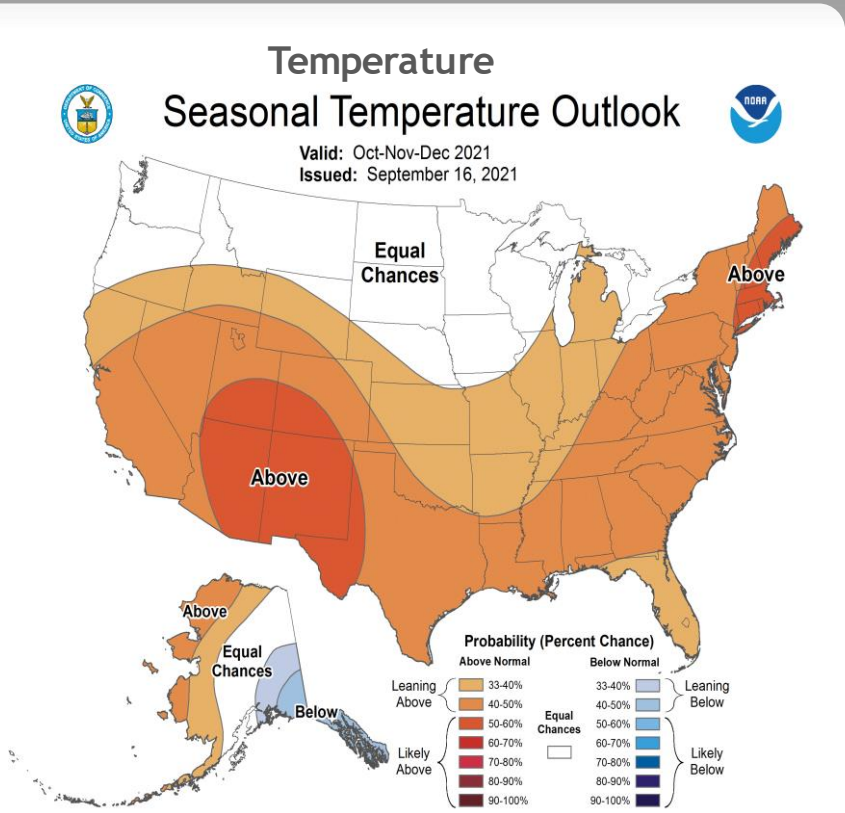


U. S. Seasonal Outlooks

October - December 2021

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.





Summary

ENSO Alert System Status: La Niña Watch

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are near-to-below average across most of the Pacific Ocean.

A transition from ENSO-neutral to La Niña is favored in the next couple of months, with a 70-80% chance of La Niña during the Northern Hemisphere winter 2021-22.*

* Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.